WE CLAIM:

1. A vector estimation system for processing a sequence of input vectors, said input vectors each comprising a plurality of elements, and said system comprising:

a digital filter with a filter vector input for receiving said sequence of input vectors and a predictor gain input for controlling characteristics of said filter, said digital filter also having both a current slowly evolving filter estimate output and a previous slowly evolving filter estimate output, said current slowly evolving filter estimate output providing a current filtered estimate value of a slowly evolving component of said sequence of input vectors and said previous slowly evolving filter estimate output providing a previous filtered estimate value of said slowly evolving component of said sequence of input vectors; and

a parameter estimator having an estimator vector input for receiving said sequence of input vectors and a previous slowly evolving filter estimate input coupled to said previous slowly evolving filter estimate output, said parameter estimator further includes a predictor gain output coupled to said predictor gain input,

wherein when said vector estimation system receives a current input vector that is one of said sequence of said input vectors, said parameter estimator provides a current predictor gain value at said predictor gain output thereby modifying said current filtered estimate value at said current slowly evolving filter estimate output, said current predictor gain value being dependent upon both said

previous filtered estimate value received at said slowly evolving filter estimate input and said current input vector received at said estimator vector input.

2. A vector estimation system as claimed in claim 1, wherein said parameter estimator is characterised by said current predictor gain value being dependent upon both a sequence of previous said input vectors and a sequence of filtered estimate values provided by successive preceding values of said previous filtered estimate value.

3. A vector estimation system as claimed in claim 2, wherein said current predictor gain value is determined by said parameter estimator calculating the following:

$$(y_n^T \cdot x_{f,n-1}) \; / \; (x_{f,n-1}^T \cdot x_{f,n-1})$$

wherein, y_n^T is the transpose of said current input vector y_n that is an nth one of said sequence of input vectors; and $x_{f,n-1}^T$ is the transpose of the previous filtered estimate value $x_{f,n-1}$ resulting from a previous input vector y_{n-1}.

4. A vector estimation system as claimed in claim 1, wherein said filter has a predictor error variance output and an observation noise variance input, said predictor error variance output providing a current predictor error variance value.

5. A vector estimation system as claimed in claim 4, wherein said parameter estimator has an observation noise variance output coupled to said observation noise variance input, and a predictor error variance input coupled to said predictor error variance output, said predictor error

variance output providing a current predictor error variance value,

wherein when said vector estimation system receives said current input vector, said parameter estimator provides a current observation noise variance value at said observation noise variance output thereby modifying said current filtered estimate value at said current slowly evolving filter estimate output, said current observation noise variance value being dependent upon said previous filtered estimate value received at said previous slowly evolving filter estimate input, said current input vector received at said estimator vector input, said current predictor gain value and said current predictor error variance value.

6. A vector estimation system as claimed in claim 5, wherein, said current observation noise variance value is determined by calculating the following:

$$(y_n^T \cdot (y_n - \alpha_n \cdot x_{f,n-1})/N) - \Sigma_{p,n}$$

wherein N is a number of elements of said current input vector y_n; $\Sigma_{p,n}$ is the current predictor error variance value associated with said current input vector y_n; α_n is said current predictor gain value; and $x_{f,n-1}$ is said previous filtered estimate value.

7. A vector estimation system as claimed in claim 1, wherein said parameter estimator has an OnsetFlag output coupled to an OnsetFlag input of said digital filter, wherein if a signal at said OnsetFlag input is below a threshold value dependent upon harmonic energy in said current input vector, said previous filtered estimate value is set to a filtered estimate value.

8. A vector estimation system as claimed in claim 7, wherein if said signal at said OnsetFlag input is below the threshold value dependent upon harmonic energy in said current input vector, said previous filtered estimate value is set to a previous input vector y_{n-1}.

9. A vector estimation system as claimed in claim 5, wherein the parameter estimator has an unvoiced speech module that determines the current input vector's harmonic energy content by assessing the current predictor gain value and depending upon the current predictor gain value the parameter estimator selectively sets the current predictor gain value and the current observation noise variance value.

10. A vector estimation system as claimed in claim 1, wherein there is a smoother module having inputs coupled respectively to at least two outputs of said digital filter.

11. A vector estimation system as claimed in claim 1, wherein said smoother module has five inputs coupled to respective outputs of said filter.

12. A vector estimation system as claimed in claim 11, wherein said smoother module has a smoothed estimate output providing a smoothed estimate value of a previous slowly evolving component.

13. A vector estimation system for processing a sequence of input vectors, said input vectors each comprising a plurality of elements, and said system comprising:

a digital filter with a filter vector input for receiving said sequence of input vectors and an observation noise variance input for controlling characteristics of said filter, said digital filter also having a current slowly evolving filter estimate output, a predictor error variance output and a previous slowly evolving filter estimate output, said current slowly evolving filter estimate output providing a current filtered estimate value of a slowly evolving component of said sequence of input vectors, said predictor error variance output providing a current predictor error variance value and said previous slowly evolving filter estimate output providing a previous filtered estimate value of said slowly evolving component of said sequence of input vectors; and

a parameter estimator having an estimator vector input for receiving said sequence of input vectors and a previous slowly evolving filter estimate input coupled to said previous slowly evolving filter estimate output, said parameter estimator further includes a observation noise variance output coupled to said observation noise variance input,

wherein when said vector estimation system receives a current input vector that is one of said sequence of said input vectors, said parameter estimator provides a current observation noise variance value at said observation noise variance output thereby modifying said current filtered estimate value at said current slowly evolving filter estimate output, said current observation noise variance value being dependent upon said current input vector, said current predictor error variance value, and said previous filtered estimate value.

14. A vector estimation system as claimed in claim 13, wherein said current observation noise variance value is determined by calculating the following:

$$(y_n^T \cdot (y_n - x_{f,n-1})/N) - \Sigma_{p,n}$$

wherein y_n^T is the transpose of said current input vector y_n that is an nth one of said sequence of input vectors; N is a number of elements of said current input vector y_n; $\Sigma_{p,n}$ is the current predictor error variance value associated with said current input vector y_n; and $x_{f,n-1}$ is said previous filtered estimate value.

15. A vector estimation system as claimed in claim 13, wherein said parameter estimator has an OnsetFlag output coupled to an OnsetFlag input of said digital filter, wherein if a signal at said OnsetFlag input is below a threshold value dependent upon harmonic energy in said current input vector, said previous filtered estimate value is set to a filtered estimate value.

16. A vector estimation system as claimed in claim 15, wherein, if said signal at said OnsetFlag input is below the threshold value dependent upon harmonic energy in said current input vector, said previous filtered estimate value is set to a previous input vector.

17. A vector estimation system as claimed in claim 13, wherein the parameter estimator has an unvoiced speech module that determines the current input vector's harmonic energy content by assessing the current predictor gain value and depending upon the current predictor gain value the parameter estimator selectively sets the current

predictor gain value and the current observation noise variance value.

18. A vector estimation system as claimed in claim 13, wherein said digital filter further includes:
a slowly evolving predicted estimate output providing a current predicted estimate value of said sequence of vectors.

19. A vector estimation system as claimed in claim 13, wherein, there is a smoother module having inputs coupled respectively to at least two outputs of said digital filter.

20. A vector estimation system as claimed in claim 19, wherein said smoother module has five inputs coupled to respective outputs of said filter.

21. A vector estimation system as claimed in claim 19, wherein said smoother module has a smoothed estimate output providing a smoothed estimate value of a previous slowly evolving component.

22. A vector estimation system as claimed in claim 21, wherein said smoothed estimate output is coupled to a smoothed estimate input of said parameter estimator.

23. A method for processing a sequence of input vectors each comprising a plurality of elements, said vectors being applied to a vector estimation system having a parameter estimator coupled to a digital filter, said method comprising the steps of:

receiving said sequence of input vectors at inputs of said filter and said parameter estimator;

determining a current predictor gain value from a current input vector that is one of said sequence of said input vectors, said determining being effected by said parameter estimator; and

applying said current predictor gain value to said digital filter to thereby modify a current filtered estimate value provided at an output of said digital filter, said current predictor gain value being dependent upon a previous filtered estimate value from said filter and said current input vector.

24. A method for processing a sequence of input vectors as claimed in claim 23, wherein said step of determining is further characterised by providing a current observation noise variance value and a current predictor error variance value from said current input vector,

25. A method for processing a sequence of input vectors as claimed in claim 23, wherein said step of applying is further characterised by said filter receiving current observation noise variance value thereby modifying said current filtered estimate value, said current observation noise variance value being dependent upon said previous filtered estimate value, said current input vector, said current predictor gain value and said current predictor error variance value.

26. A method for processing a sequence of input vectors each comprising a plurality of elements, said vectors being applied to a vector estimation system having a parameter estimator coupled to a digital filter, said method comprising the steps of:

receiving said sequence of input vectors at inputs of said filter and said parameter estimator;

determining a current observation noise variance value from a current input vector that is one of said sequence of said input vectors, said determining being effected by said parameter estimator; and

applying said current observation noise variance value to said digital filter to thereby modify a current filtered estimate value provided at an output of said digital filter, said current observation noise variance value being dependent upon said current input vector, a current predictor error variance value from said filter, and a previous filtered estimate value from said filter.

27. An encoder for processing a speech signal each comprising a plurality of elements, and said encoder comprising:

a signal normalization module for processing the speech signal to provide a sequence of input vectors each comprising a plurality of elements;

a digital filter with a filter vector input coupled to an output of the signal normalization module for receiving said sequence of input vectors, the digital filter also having an observation noise variance input for controlling characteristics of said filter, said digital filter also having a current slowly evolving filter estimate output, a predictor error variance output and a previous slowly evolving filter estimate output, said current slowly evolving filter estimate output providing a current filtered estimate value of a slowly evolving component of said sequence of input vectors, said predictor error variance output providing a current predictor error variance value and said previous slowly evolving filter estimate output providing a previous filtered

estimate value of said slowly evolving component of said sequence of input vectors;

a parameter estimator having an estimator vector input for receiving said sequence of input vectors and a previous slowly evolving filter estimate input coupled to said previous slowly evolving filter estimate output, said parameter estimator further includes a observation noise variance output coupled to said observation noise variance input; and

a slowly evolving component encoder with an input coupled to said slowly evolving filter estimate output, wherein when said vector estimation system receives a current input vector that is one of said sequence of said input vectors, said parameter estimator provides a current observation noise variance value at said observation noise variance output thereby modifying said current filtered estimate value at said current slowly evolving filter estimate output, said current observation noise variance value being dependent upon said current input vector, said current predictor error variance value, and said previous filtered estimate value.

28. An encoder for processing a speech signal as claimed in claim 27, the encoder further including an adder module with one input coupled said slowly evolving filter estimate output and another input coupled to the output of the signal normalization module, wherein in use said adder subtracts the said current filtered estimate value at the output of the vector estimation system from at least one of the elements of the sequence of input vectors.

29. An encoder for processing a speech signal as claimed in claim 27, wherein an output of the adder module is coupled to a rapidly evolving component encoder.

30. An encoder for processing a speech signal as claimed in claim 27, wherein said parameter estimator is characterised by said current observation noise variance value being dependent upon both a sequence of previous said input vectors and a sequence of filtered estimate values provided by successive preceding values of said previous filtered estimate value.